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Rodney J Allam

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EXAMINER

LEUNG, JENNIFER A

ART UNIT

PAPER NUMBER

1797

NOTIFICATION DATE

DELIVERY MODE

09/22/2009

ELECTRONIC

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

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<b>Office Action Summary</b>	<b>Application No.</b> 10/524,325	<b>Applicant(s)</b> ALLAM ET AL.	
	<b>Examiner</b> JENNIFER A. LEUNG	<b>Art Unit</b> 1797	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 08 June 2009.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-19, 21-25 and 27-29 is/are pending in the application.
- 4a) Of the above claim(s) 1-18 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 19, 21-25 and 27-29 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                       | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | Paper No(s)/Mail Date. _____                                      |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>8/5/09</u> .  | 6) <input type="checkbox"/> Other: _____                          |

## DETAILED ACTION

### *Response to Amendment*

1. Applicant's amendment filed on June 8, 2009 has been considered. Claims 20 and 26 are cancelled. Claims 1-18 are withdrawn. Claims 19, 21-25 and 27-29 are under consideration.

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

2. Claims 19, 22-24 and 27-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Banquy '096 (US 4,782,096) in view of Fong et al. (US 5,496,859), Banquy '130 (US 4,888,130), Davis et al. ("Cryogenics for Syngas Processing", *Chemical Engineering Progress*, February 1980, pages 72-79) and McNeil et al. (US 6,073,461).

Regarding claim 19, Banquy '096 (FIGs. 1-3) discloses an apparatus comprising:  
a syngas generation system (i.e., comprising a "primary steam reforming" zone and a "secondary oxygen reforming" zone; in detail in FIG. 2) generating syngas **11** by reaction of methane

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**2** with steam **5** and oxygen **8**, (see, e.g., column 6, line 19 to column 9, line 3); a syngas conversion system (i.e., a “synthesis loop”; in detail in FIG. 3) converting syngas **11** into higher molecular weight hydrocarbon compounds or oxygenates **14** and producing an offgas **15**, (see, for example, column 9, lines 13-46); and a physical separation zone for separating the various components contained in the offgas **15** produced by the syngas conversion system.

i) For the syngas generation system, Banquy ‘096 fails to disclose the instantly claimed syngas generation system, in which the heat for endothermic syngas generation is produced by exothermic reaction of the gas comprising methane with the oxidant gas.

Fong et al., however, teaches a syngas generation system (FIG. 1; column 3, line 65 to column 5, line 34) configured to generate syngas comprising CO and hydrogen by reaction of a gas comprising methane (i.e., in stream **1**) with steam (i.e., in stream **5**) and oxygen (i.e., in stream **2**), wherein heat for the endothermic syngas generation (i.e., conducted in the tube side of the steam reforming catalytic reactor) is produced by exothermic reaction of the gas comprising methane with oxygen (i.e., the product stream from the partial oxidation reactor or gasifier is passed to the shell side of the steam reforming catalytic reactor, to provide heat to the tube side reaction; column 4, lines 26-38). Fong et al. specifically teaches that such a system is an improvement over the prior art syngas generation system in U.S. Pat. No. 4,888,130, or Banquy ‘130 (Fong et al.: column 2, lines 6-53). It is noted that the syngas generation system in Banquy ‘130 (see figure) is the same as the syngas generation system in Banquy ‘096 (see FIG. 2).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to substitute the syngas generation system of Fong et al. for the syngas generation

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system of Banquy '096, because the syngas generation system of Fong et al. is able to produce stoichiometric ratioed synthesis gas at elevated pressures, while minimizing or eliminating the need for external compression (see, e.g., column 2, lines 45-53; column 3, lines 7-20 and 40-52).

ii) For the physical separation zone, Banquy '096 (see column 9, lines 55-68) discloses that “[a]ny physical separation process can be used” and, in particular, “[t]he physical separation can... be achieved by cryogenic techniques, or distillation at low temperature, such as outlined in *Chemical Engineering Progress*, February 1980, pages 72-79 ...” to Davis et al.

Looking at the cited publication, Davis et al. teaches a physical separation zone (see Figure 2, showing the “methane wash approach”) that separates a feed gas into a hydrogen product, a CO product, and a fuel; wherein the separation zone comprises: a cryogenic separation system (i.e., a methane wash column) that produces the hydrogen product (i.e., in the overhead) and a first cryogenic liquid stream comprising carbon monoxide (i.e., in the bottoms); and a cryogenic distillation column (i.e., CO/CH<sub>4</sub> fractionator) for separating carbon monoxide from the first cryogenic liquid stream to produce the CO product (i.e., in the overhead) and substantially carbon monoxide-free cryogenic liquid (i.e., in the bottoms), usable as fuel; (see also page 74, beginning of column 2, to page 75, end of column 1).

The collective teaching of Banquy '096 and Davis et al., however, is silent as to the physical separation zone having the instantly claimed configuration of a first liquid methane wash column, a second liquid methane wash column, a nitrogen rejection column, and a cryogenic distillation column.

McNeil et al. teaches a physical separation zone (see Figure 1; generally, column 4, line 7 to column 7, line 67) that, similarly to Davis et al., separates a feed gas 1 into a hydrogen product

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**54**, a CO product **44**, and a fuel **53**; wherein the separation zone comprises:

a first liquid methane wash column (i.e., column **8**, supplied with liquid methane from line **36** and pump **38**) configured to separate hydrogen from the feed gas **1** to produce a separated hydrogen product that is substantially free of carbon monoxide (i.e., leaving as overhead, via line **12** to the hydrogen rich product line **54**) and a first cryogenic liquid comprising carbon monoxide and residual hydrogen (i.e., leaving as bottoms, via line **13**), (see column 5, line 56 to column 6, line 2; column 6, lines 54-56);

a second liquid methane wash column (i.e., column **15**, supplied with liquid methane from line **14**) configured to separate the residual hydrogen from the first cryogenic liquid (i.e., fed by line **13**) to produce separated hydrogen usable as a fuel by-product (i.e., leaving as overhead, via line **19** to the fuel gas product line **53**) and a second cryogenic liquid comprising carbon monoxide (i.e., leaving as bottoms, via line **18**), (see column 6, lines 7-24; column 7, lines 21-67);

a nitrogen rejection column (i.e., nitrogen-separation fractionation column **22**) configured to separate nitrogen (i.e., leaving as overhead, in line **25**) from said second cryogenic liquid (i.e., fed by line **18**) to produce a third cryogenic liquid (i.e., leaving as bottoms, in line **26**), (see column 6, lines 25-37); and

a cryogenic distillation column (i.e., a methane-separation fractionation column **32**) configured to separate carbon monoxide from said third cryogenic liquid (i.e., fed by line **26**) to produce separated carbon monoxide product (i.e., leaving as overhead, in line **35** to the CO product line **44**) and a substantially carbon monoxide-free cryogenic liquid (i.e., leaving as bottoms, in line **36**), (see column 6, lines 38-53).

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It would have been obvious for one of ordinary skill in the art at the time the invention was made to select the physical separation zone as taught by McNeil et al. for the physical separation zone in the modified apparatus of Banquy '096, because any physical separation process can be used, and a physical separation process employing cryogenic techniques or distillation at low temperature is specifically suggested as being suitable (see Banquy '096: column 9, lines 55-65). Like the cited publication to Davis et al., the physical separation zone of McNeil et al. separates a feed gas into a hydrogen product, a CO product, and a fuel. However, one having ordinary skill in the art would have been motivated to provide the physical separation zone of McNeil et al. in the apparatus of Banquy '096 because, unlike conventional cryogenic techniques (such as Davis et al.), the separation zone of McNeil et al. further removes nitrogen contaminant from the carbon monoxide product, which would be desirable for environmental and processing reasons (see McNeil et al.: column 1, lines 16-35).

Regarding claim 22, as noted above, the modified apparatus of Banquy '096 produces a CO product via physical separation (see McNeil et al.: CO product stream in conduit **44**; FIG. 1). Furthermore, CO is considered a reactant in the syngas conversion system, i.e., in the synthesis of hydrocarbons or oxygenates (see Banquy '096: column 1, lines 10-18, 20-33). Accordingly, it would have been obvious for one of ordinary skill in the art at the time the invention was made to provide conduit means for feeding the carbon monoxide product to the syngas conversion system in the modified apparatus of Banquy '096, because one having ordinary skill in the art would have recognized the carbon monoxide product to be a readily available source of reactant for the syngas conversion system. Also, the recycling of un-reacted reactants or products for further processing, which advantageously reduces material costs and environmental impact,

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would have been considered well known to those having ordinary skill in the engineering art.

Regarding claim 23, Banquy '096 further discloses that the residual gas stream contains argon (see column 9, lines 46-54). Thus, the modified apparatus of Banquy '096 inherently comprises conduit means for removing an argon-enriched stream from a location in the region of high argon concentration in the cryogenic distillation column (i.e., via the bottoms of the methane-separation fraction column **32**, as taught by McNeil et al.; see column 5, lines 10-13).

Regarding claim 24, as noted above, the modified apparatus of Banquy '096 produces a liquid methane product via physical separation (see McNeil et al.: e.g., liquid methane in line **36**, discharged via conduit **53**; FIG. 1). Furthermore, Fong et al. teaches that the syngas generation system (see FIG. 1; column 3, line 65 to column 4, line 5) consumes methane, e.g., as a feedstock for reforming, or as a fuel for the fired heater. Accordingly, it would have been obvious for one of ordinary skill in the art at the time the invention was made to provide conduit means for feeding the methane product to the syngas generation system in the modified apparatus of Banquy '096, i.e., as a feedstock for reforming or a fuel for the fired heater, because one having ordinary skill in the art would have recognized the methane product to be a readily available source of reactant or fuel for the syngas generation system. Also, the recycling of unreacted reactants or products for further processing, which advantageously reduces material costs and environmental impact, would have been considered well known to those having ordinary skill in the engineering art.

Regarding claim 27, Banquy '096 (see column 9, lines 47-54, with emphasis added) further discloses,

*“The purge gas (stream **15**) extracted from the synthesis loop is subjected to a physical separation to split it into a hydrogen-rich stream, a portion of which will be*



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*mixed with the raw synthesis gas to form the final synthesis gas, and a residual gas stream which contains essentially methane, carbon oxides, argon, nitrogen and some hydrogen, and which can be used as fuel in the primary steam reformer.”*

As seen in FIGs. 1, 4 and 5, the apparatus further comprises conduit means **12** for removing a portion of the separated hydrogen product, in order to recycle the hydrogen to the syngas conversion system (i.e., the synthesis loop) for generation of higher molecular weight hydrocarbon compounds or oxygenates **14**. Please note that the recitation of a particular molar concentration of helium within the separated hydrogen product stream is considered a process limitation that adds no further patentable weight to the apparatus claim.

Regarding claim 28, Fong et al. teaches a partial oxidation reactor for conducting the reaction of methane with the oxidant gas (see column 4, lines 6-25), and an enhanced heat transfer reformer for conducting the reaction of methane with the steam (see column 4, lines 25-56; also, column 5, lines 23-51).

Regarding claim 29, Banquy '096 discloses that the syngas conversion system comprises at least one FT reactor (i.e., a synthesis converter **SC**, for reacting hydrogen with carbon monoxide, carbon dioxide or mixtures of these carbon oxides to yield organic compounds, such as a hydrocarbon, a mixture of hydrocarbons, an oxygenated compound, or any mixture thereof (see FIG. 3; see column 9, lines 4-46; also, column 1, lines 10-17, lines 20-34).

3. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Banquy '096 (US 4,782,096) in view of Fong et al. (US 5,496,859), Banquy '130 (US 4,888,130), Davis et al. (“Cryogenics for Syngas Processing”, *Chemical Engineering Progress*, February 1980, pages 72-79) and McNeil et al. (US 6,073,461), as applied to claim 19 above, and further in view of

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Ireland et al. (US 4,044,063).

The collective teaching of Banquy '096, Fong et al., Banquy '130, Davis et al. and McNeil et al. is silent as to the apparatus further comprising a hydrogenation system.

Ireland et al. (FIG. 1; see, for example, column 8, line 15 to column 9, line 3) teaches a hydrogenation system (e.g., hydrotreating unit **56**; or hydrodewaxing unit **62**) for hydrogenating a fraction of the higher molecular weight hydrocarbon compounds **54**, **60** produced by a syngas conversion system (i.e., in F-T synthesis zone **4**).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to further provide a hydrogenation system to the modified apparatus of Banquy '096, on the basis of suitability for the intended use thereof, because the provision of a hydrogenation system helps maximize the production of further liquid hydrocarbon products from the Fischer-Tropsch reaction products stream, as taught by Ireland et al.

4. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Banquy '096 (US 4,782,096) in view of Fong et al. (US 5,496,859), Banquy '130 (US 4,888,130), Davis et al. ("Cryogenics for Syngas Processing", *Chemical Engineering Progress*, February 1980, pages 72-79) and McNeil et al. (US 6,073,461), as applied to claim 19 above, and further in view of Keller (US 4,650,814).

Banquy '096 discloses that "[a]ny physical separation process can be used" in the physical separation zone and, in particular, "[a]nother physical separation for this purpose is the membrane separation process, which is described in Hydrocarbon Processing May 1980 pages 115-118, and July 1980 pages 65-67," (column 9, lines 55-68).

The collective teaching of Banquy '096, Fong et al., Banquy '130, Davis et al. and

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McNeil et al., however, is silent as to the provision of a membrane separation system, for removing helium from the separated hydrogen product.

Keller (FIG. 3) teaches a membrane separation system **325** for removing inert gases **344** such as helium (see column 7, lines 6-17) from a separated hydrogen product stream **330**. (see column 13, line 10 to column 14, line 34; see column 15, lines 10-36; see also FIG. 1, column 8, line 14 to column 9, line 8).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to further provide a membrane separation system in the modified apparatus of Banquy '096, on the basis of suitability for the intended use thereof, because the membrane separation system enables the generation of a high purity hydrogen stream for use as a recycle, while minimizing the amount of inert compound build-up in the system by separating and removing any inert gases, such as helium, from the system, as taught by Keller.

### ***Response to Arguments***

5. Applicant's arguments filed June 8, 2009 have been fully considered but they are not persuasive. Applicant (at page 9, last paragraph) argues,

“... the offgas is separated into an unreacted hydrogen, unreacted carbon monoxide, nitrogen, and a substantially carbon monoxide-free cryogenic liquid. For the teaching of this limitation, the Examiner offers the stream 15 disclosed in *Banquy '096* and the discussion of physically separating the stream 15 into a hydrogen-rich stream and fuel for the primary stream reformer. Col. 9, lines 47-54. While *Banquy '096* does cite *Davis* for cryogenic separation techniques that may be used to generate the two streams, Applicants submit that *Banquy '096* fails to teach or suggest generating a nitrogen stream, a carbon monoxide stream, and a substantially carbon monoxide-free cryogenic liquid. In fact, *Banquy '096* merely teaches generating two streams. The first

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stream is a hydrogen-rich stream to mix with the syngas, and the second stream is fuel for the stream reformer. Accordingly, Applicants respectfully request reconsideration and allowance of claim 19 and its dependents.”

The Examiner agrees that Banquy '096 only discusses the separation of the purge gas stream **15** into two separate streams— i) a hydrogen-rich stream which contains unreacted hydrogen, and ii) a residual gas stream which contains, at least, unreacted carbon oxides and nitrogen (see column 9, lines 47-54). Applicant’s argument, however, is not considered to be persuasive, because the rejection is based on a combination of references. One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

In particular, Banquy '096 was modified by the secondary references to Davis et al. and McNeil et al. in order to teach the physical separation of the hydrogen and carbon monoxide containing purge gas stream **15** into its various components via cryogenic techniques.

The Davis et al. reference was specifically cited in Banquy '096 (see column 9, lines 61-65). As seen in the Figure 2, when cryogenic separation techniques are employed, separate streams for hydrogen (i.e., as H<sub>2</sub> Product), carbon monoxide (as CO product) and substantially carbon monoxide-free cryogenic liquid stream (i.e., exiting the bottom of the CO/CH<sub>4</sub> fractionator) will ultimately result.

The McNeil et al. reference was further cited by the Examiner for teaching the claimed cryogenic separation elements, including a first liquid methane wash column, a second liquid methane wash column, a nitrogen rejection column, and a cryogenic distillation column. The McNeil et al. apparatus produces the same product streams as the Davis et al. apparatus (i.e.,

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including a hydrogen stream, a carbon monoxide stream, and a cryogenic liquid stream), and it also produces a nitrogen stream.

It would have been obvious for one of ordinary skill in the art at the time the invention was made to specifically provide the cryogenic separation apparatus of McNeil et al. for conducting the physical separation of the purge gas stream in the apparatus of Banquy '096 because, unlike conventional cryogenic techniques (such as in Davis et al.), the apparatus of McNeil et al. further allows for the separation of nitrogen contaminant from the unreacted carbon monoxide stream. This would be desirable for environmental and processing reasons (see McNeil et al.: column 1, lines 16-35).

When a gas stream containing the components of the purge gas stream **15** of Banquy '096 (i.e., including unreacted hydrogen, unreacted carbon monoxide and nitrogen) is fed to the cryogenic separation apparatus of McNeil et al. (i.e., via feed gas inlet **1**; FIG. 1), the four recited streams will ultimately result— i) an unreacted hydrogen stream (e.g., via the hydrogen rich product line **54**), ii) an unreacted carbon monoxide stream (i.e., leaving as overhead, in line **35** to the CO product line **44**), iii) a nitrogen stream (i.e., leaving as overhead in line **25**), and iv) a substantially carbon monoxide-free cryogenic liquid stream (i.e., leaving as bottoms, in line **36**).

### ***Conclusion***

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after

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the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

\* \* \*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JENNIFER A. LEUNG whose telephone number is (571) 272-1449. The examiner can normally be reached on 9:30 am - 5:30 pm Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Walter D. Griffin can be reached on (571) 272-1447. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Jennifer A. Leung/  
Primary Examiner, Art Unit 1797